

1 What is claimed is:

1 1. An apparatus comprising:

2 a pulsed laser that includes a fiber optical gain medium and having a pulse
3 repetition rate of more than 50000 pulses per second and a per-pulse length of less
4 than one picosecond; and

5 an optical path including a scanning head operably coupled to receive laser
6 light from the pulsed laser and operable to scan an output light pattern suitable to
7 sculpt tissue for a surgical procedure using at least 100000 pulses in less than ten
8 seconds.

1 2. The apparatus of claim 1, wherein the surgical procedure is a complete
2 surface cut of an ophthalmologic surgical procedure, the cut defining a surface, at
3 least a portion of which is within a corneal stroma.

1 3. The apparatus of claim 1, wherein the surgical procedure uses at least 200000
2 pulses in less than five seconds.

1 4. The apparatus of claim 1, wherein the surgical procedure uses at least 200000
2 pulses in less than two seconds.

1 5. The apparatus of claim 1, wherein the surgical procedure forms a first cut that
2 defines a posterior surface of a lenticule within a corneal stroma, a second cut that
3 defines a lenticule anterior surface of the lenticule, and a slit cut that extends to the
4 cornea surface, wherein the three cuts are completed within five seconds.

1 6. The apparatus of claim 5, wherein the slit cut either forms or subtends an arc
2 of less than 180 degrees measured from the lenticule's center.

1 7. The apparatus of claim 1, wherein the surgical procedure forms a first cut that
2 defines a posterior surface of a corneal flap that can be folded back to expose a
3 stroma surface to allow a conventional LASIK operation on the exposed stroma
4 surface, wherein the first cut is completed within two seconds.

1 8. The apparatus of claim 1, further comprising a precompressor that creates a
2 negative dispersion in each pulse that compensates for a dispersion of the optical
3 path after the precompressor.

1 9. The apparatus of claim 1, wherein the scanning head focuses at least 100000
2 pulses per second and the per-pulse length is less than 500 femtoseconds.

1 10. The apparatus of claim 1, wherein the scanning head focuses at least about
2 200000 pulses per second and the per-pulse length is less than 400 femtoseconds.

1 11. A method comprising:
2 generating a stream of optical pulses having a pulse repetition rate of at least
3 about 50000 pulses per second and a per-pulse length of less than one picosecond
4 using an optical fiber gain medium; and
5 scanning and focusing the stream to an output light pattern suitable to sculpt
6 tissue for a surgical procedure using at least 100000 pulses in less than ten seconds.

1 12. The method of claim 11, wherein the surgical procedure is a complete surface
2 cut of an ophthalmologic surgical procedure, the cut defining a surface, at least a
3 portion of which is within a corneal stroma.

1 13. The method of claim 11, wherein the scanning and focusing uses at least
2 200000 pulses to form at least one cut that is completed in less than five seconds.

1 14. The method of claim 11, wherein the scanning and focusing uses at least
2 200000 pulses to form at least one cut that is completed in less than two seconds.

1 15. The method of claim 11, wherein the scanning and focusing forms a first cut
2 that defines a posterior surface of a lenticule within a corneal stroma, a second cut
3 that defines an lenticule anterior surface of the lenticule, and a slit cut that extends to
4 the cornea surface, wherein the three cuts are completed within five seconds.

1 16. The method of claim 15, wherein the slit cut either forms or subtends an arc
2 of less than 180 degrees measured from the lenticule's center.

1 17. The method of claim 11, wherein the surgical procedure forms a first cut that
2 defines a posterior surface of a corneal flap that can be folded back to expose a
3 stroma surface to allow a LASIK operation on the exposed stroma surface, wherein
4 the first cut is completed within two seconds.

1 18. The method of claim 11, further comprising precompressing each pulse to
2 create a negative dispersion that compensates for a dispersion of an optical path after
3 the precompressor.

1 19. The method of claim 11, wherein the scanning and focusing focuses at least
2 100000 pulses per second and the per-pulse length is less than 500 femtoseconds.

1 20. The method of claim 11, wherein the scanning and focusing focuses at least
2 about 200000 pulses per second and the per-pulse length is less than 400
3 femtoseconds.

1 21. An apparatus comprising:
2 optical fiber means for generating a stream of pulses having a pulse repetition
3 rate of at least about 50000 pulses per second and a per-pulse length of less than one
4 picosecond; and
5 means for scanning and focusing the stream to an output light pattern suitable
6 to sculpt tissue for a surgical procedure using at least 100000 pulses in less than ten

7 seconds.

1 22. The apparatus of claim 21, wherein the means for scanning and focusing is
2 operable to form a complete cut for an ophthalmologic surgical procedure, the cut
3 defining a surface, at least a portion of which is within a corneal stroma.

1 23. The apparatus of claim 21, wherein the scanning and focusing uses at least
2 200000 pulses to form at least one cut that is completed in less than five seconds.

1 24. The apparatus of claim 21, wherein the scanning and focusing uses at least
2 200000 pulses to form at least one cut that is completed in less than two seconds.

1 25. The apparatus of claim 21, wherein the means for scanning and focusing is
2 operable to form a first cut that defines a posterior surface of a lenticule within a
3 corneal stroma, a second cut that defines an lenticule anterior surface of the lenticule,
4 and a slit cut that extends to the cornea surface, wherein the three cuts are completed
5 within five seconds.

1 26. The apparatus of claim 25, wherein the slit cut either forms or subtends an arc
2 of less than 180 degrees measured from the lenticule's center.

1 27. The apparatus of claim 21, wherein the surgical procedure forms a first cut
2 that defines a posterior surface of a corneal flap that can be folded back to expose a
3 stroma surface to allow a LASIK operation on the exposed stroma surface, wherein
4 the first cut is completed within two seconds.

1 28. The apparatus of claim 21, further comprising means for precompressing
2 each pulse to create a negative dispersion that compensates for a dispersion of an
3 optical path after the precompressor.

1 29. The apparatus of claim 21, wherein the means for scanning and focusing

2 focuses at least 100000 pulses per second and the per-pulse length is less than 500
3 femtoseconds.

1 30. The apparatus of claim 21, wherein the means for scanning and focusing
2 focuses at least about 200000 pulses per second and the per-pulse length is less than
3 400 femtoseconds.

1 31. An apparatus comprising:
2 a pulsed laser comprising a fiber optical amplifier and having a per-pulse
3 length of less than one picosecond; and
4 an optical path including a scanning head operably coupled to receive laser
5 light from the pulsed laser and operable to scan an output light pattern suitable to
6 sculpt tissue for a surgical procedure.

1 32. The apparatus of claim 31, wherein the surgical procedure is a complete
2 surface cut of an ophthalmologic surgical procedure, the cut defining a surface, at
3 least a portion of which is within a corneal stroma.

1 33. The apparatus of claim 31, wherein the surgical procedure uses at least
2 200000 pulses in less than five seconds.

1 34. The apparatus of claim 31, wherein the surgical procedure uses at least
2 200000 pulses in less than two seconds.

1 35. The apparatus of claim 31, wherein the surgical procedure forms a first cut
2 that defines a posterior surface of a lenticule within a corneal stroma, a second cut
3 that defines a lenticule anterior surface of the lenticule, and a slit cut that extends to
4 the cornea surface, wherein the three cuts are completed within five seconds.

1 36. The apparatus of claim 35, wherein the slit cut either forms or subtends an arc
2 of less than 180 degrees measured from the lenticule's center.

1 37. The apparatus of claim 31, wherein the surgical procedure forms a first cut
2 that defines a posterior surface of a corneal flap that can be folded back to expose a
3 stroma surface to allow a conventional LASIK operation on the exposed stroma
4 surface, wherein the first cut is completed within two seconds.

1 38. The apparatus of claim 31, further comprising a precompressor that creates a
2 negative dispersion in each pulse that compensates for a dispersion of the optical
3 path after the precompressor.

1 39. The apparatus of claim 31, wherein the scanning head focuses at least 100000
2 pulses per second and the per-pulse length is less than 500 femtoseconds.

3 40. The apparatus of claim 31, wherein the scanning head focuses at least about
4 200000 pulses per second and the per-pulse length is less than 400 femtoseconds.

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